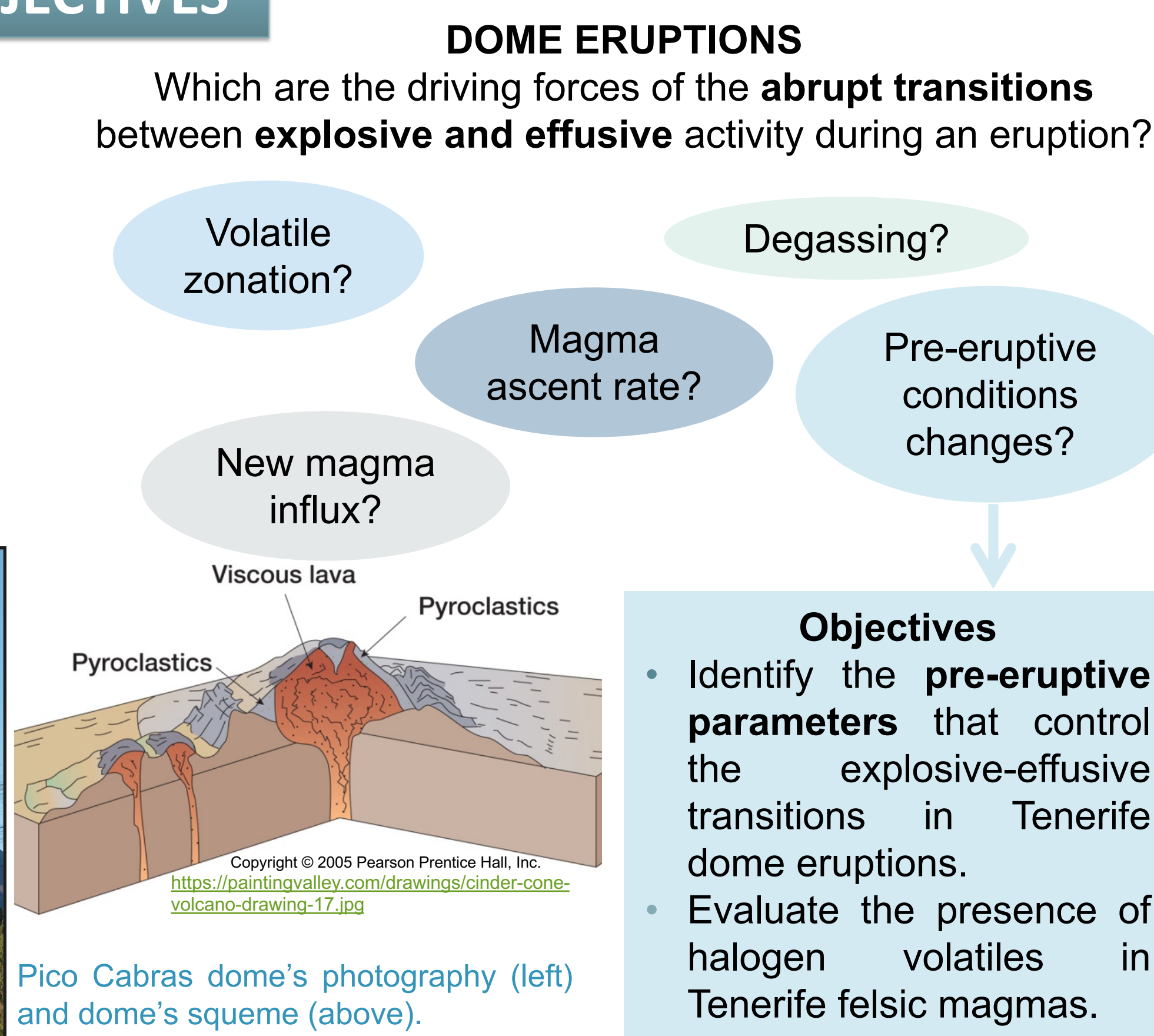
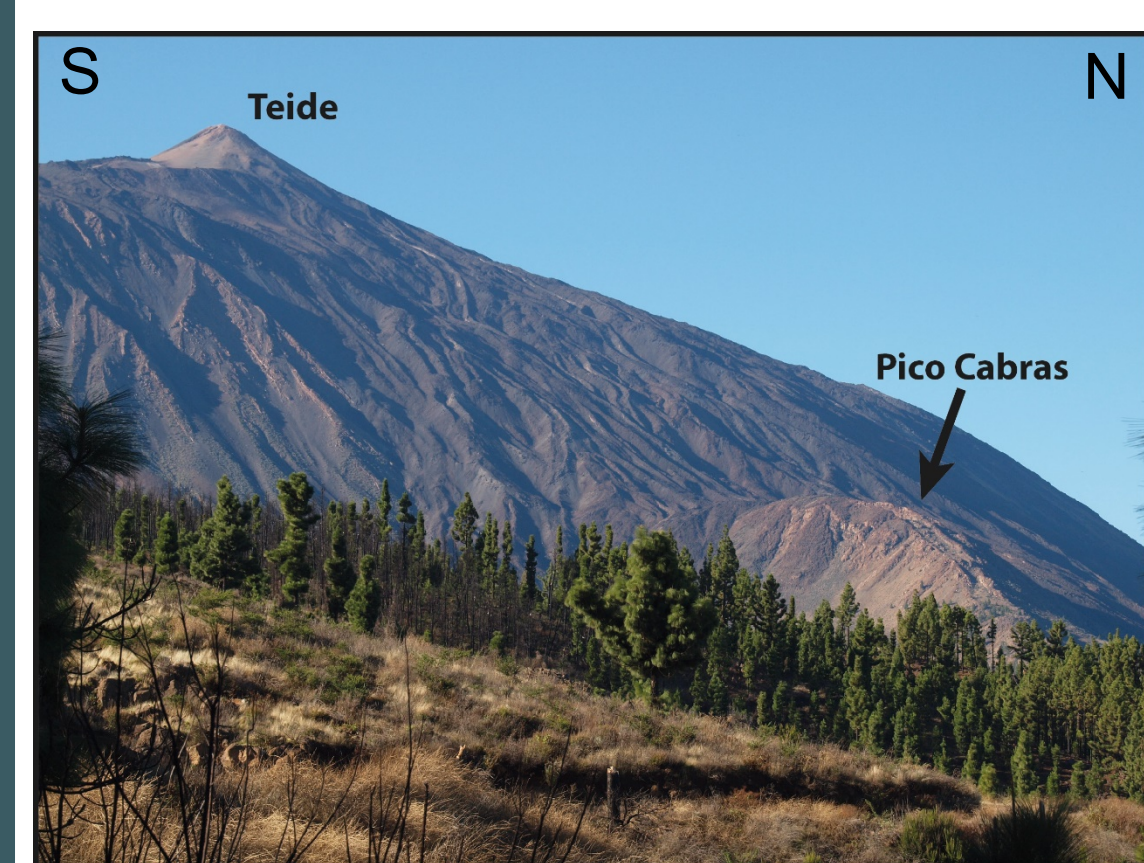


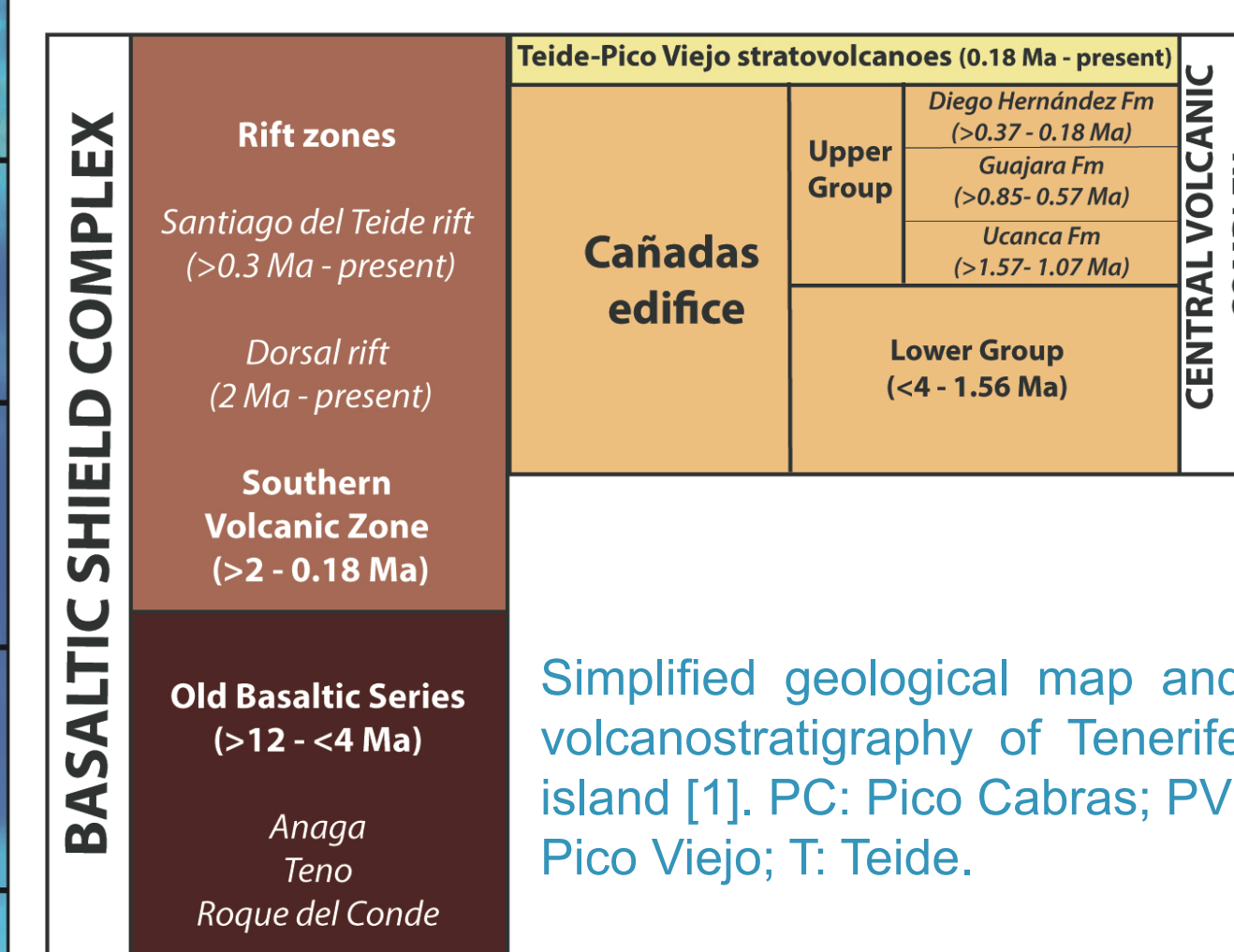
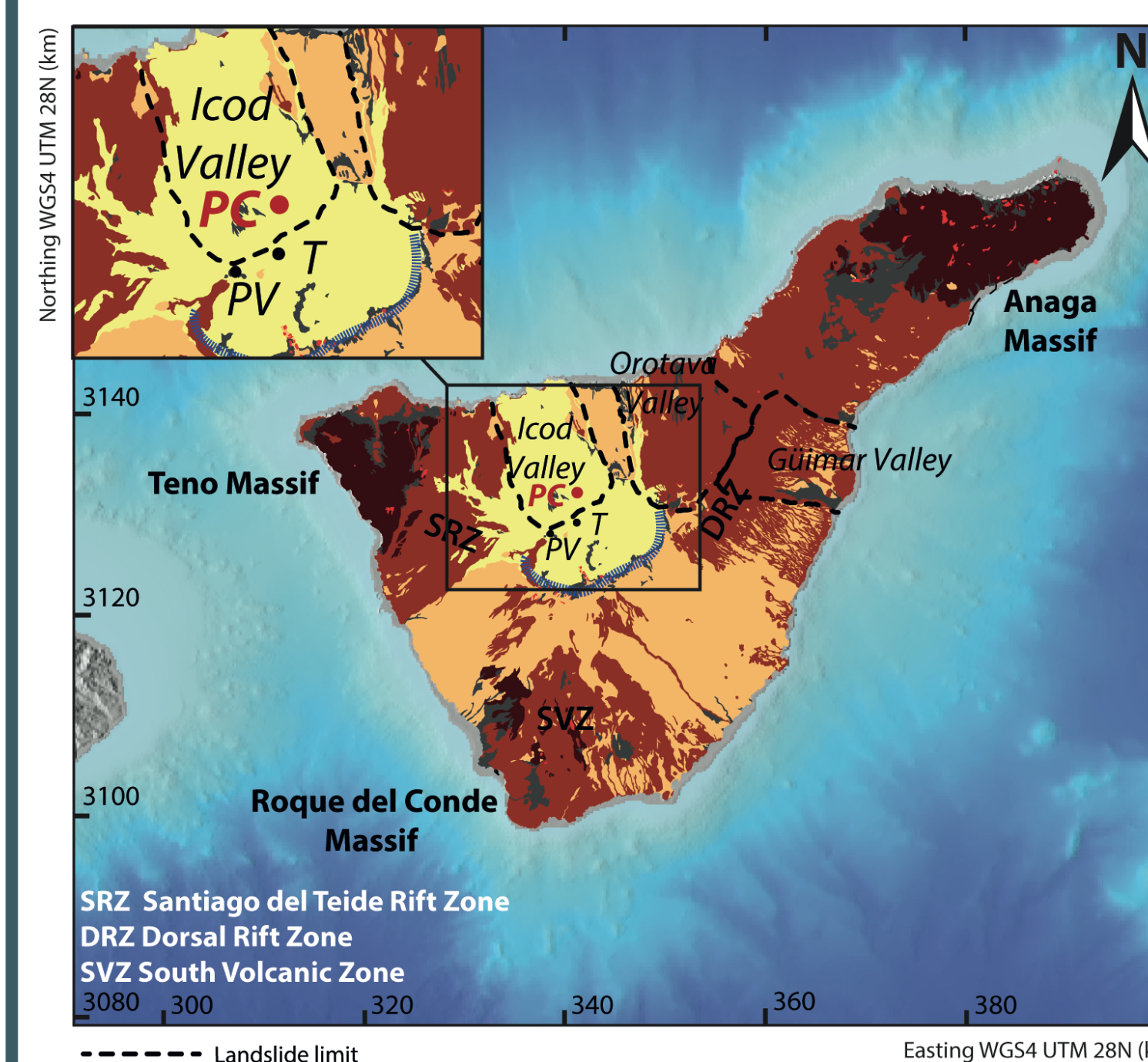
INTRODUCTION AND OBJECTIVES

The **geological record** allows us to evaluate the eruptive sequences and the eruptions' explosivity index.

This is vital for a correct hazard assessment, especially in volcanic systems with high return period.



GEOLOGICAL CONTEXT



The Upper Group of the Central Volcanic Complex comprise the products of 3 volcanic cycles that end with a caldera collapse. Teide-Pico Viejo Complex is the result of the beginning of the 4th cycle.

Tenerife island volcanism is **bimodal**: basaltic magmas (high recurrence and low magnitude), and phonolitic (low recurrence and high magnitud). The later is only found in T-PV complex, in central and lateral (**domes**) vents.

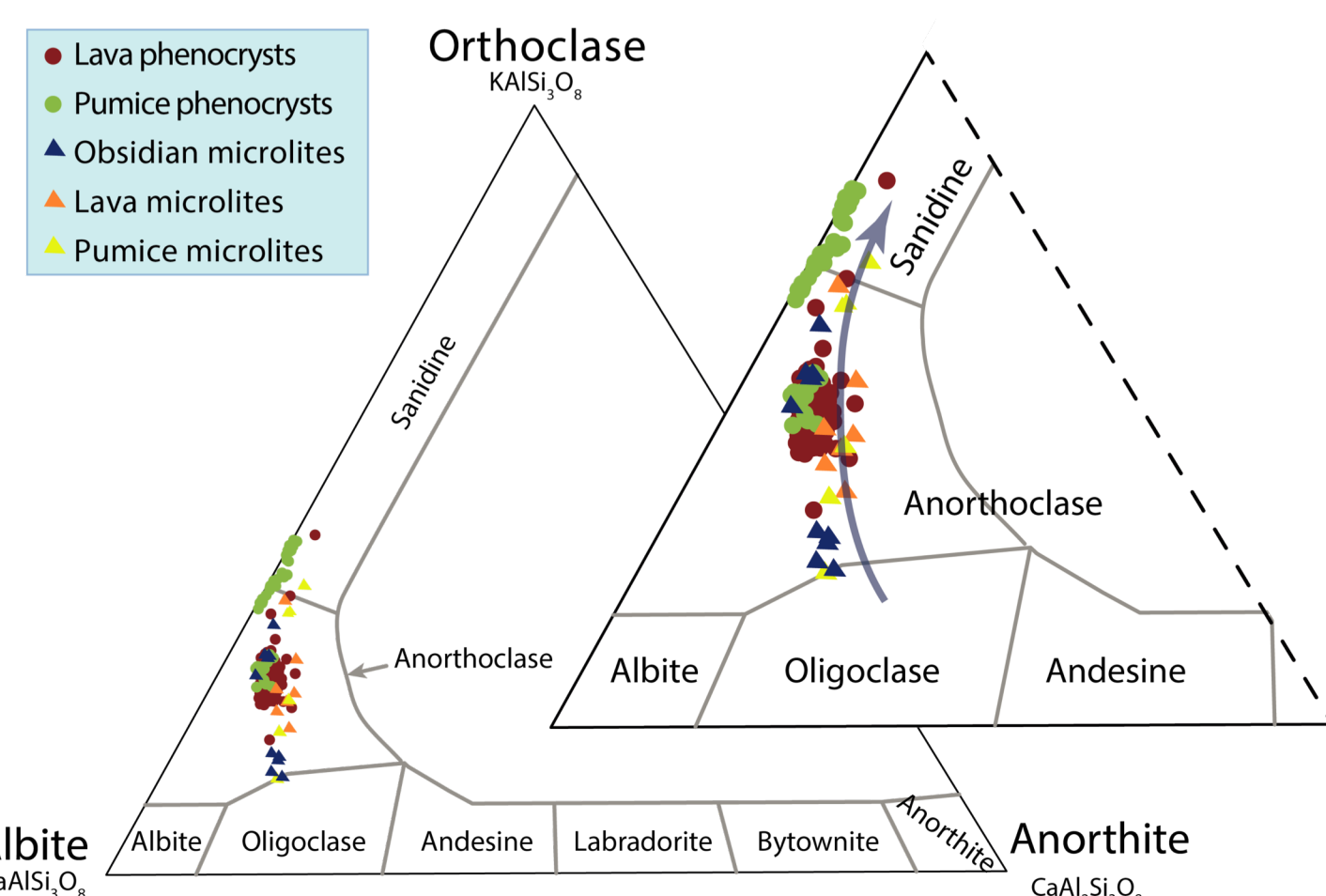
METHODOLOGY

- Petrographic** characterization of samples from the **effusive** (lava flows) and the **explosive** (pumice) phases of Pico Cabras dome eruption, using both petrographic and scanning electron microscopes.
- Geochemical** analysis using an electron microprobe (major elements) and micro-X-ray fluorescence (for Br quantification).
- Pre-eruptive parameters**: geothermobarometer [2] and geohygrometer [3]. These use the chemical composition of minerals (clinopyroxene and feldspar, respectively) and the magma in **equilibrium**.
- Comparison with **experimental petrology** data: [4-6].

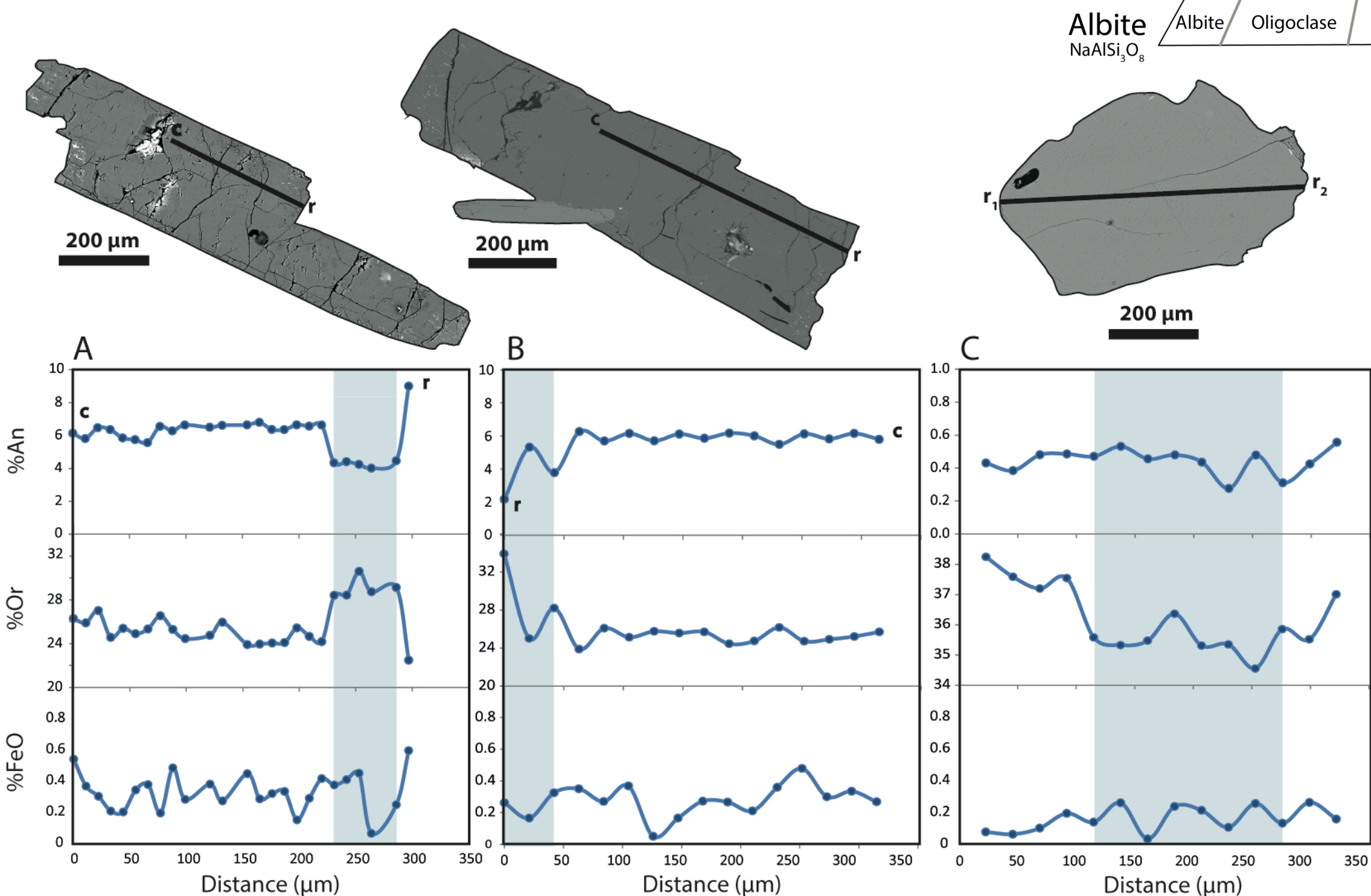
RESULTS: GEOCHEMISTRY

Feldspar

Feldspar classification diagram [7]



- Continuous **evolution** from oligoclase (less evolved magmas) to sanidine compositions (more evolved magmas).
- Less fractionated** feldspars (low or negative fractionation index "log(or/An)") are also slightly **enriched in iron**.



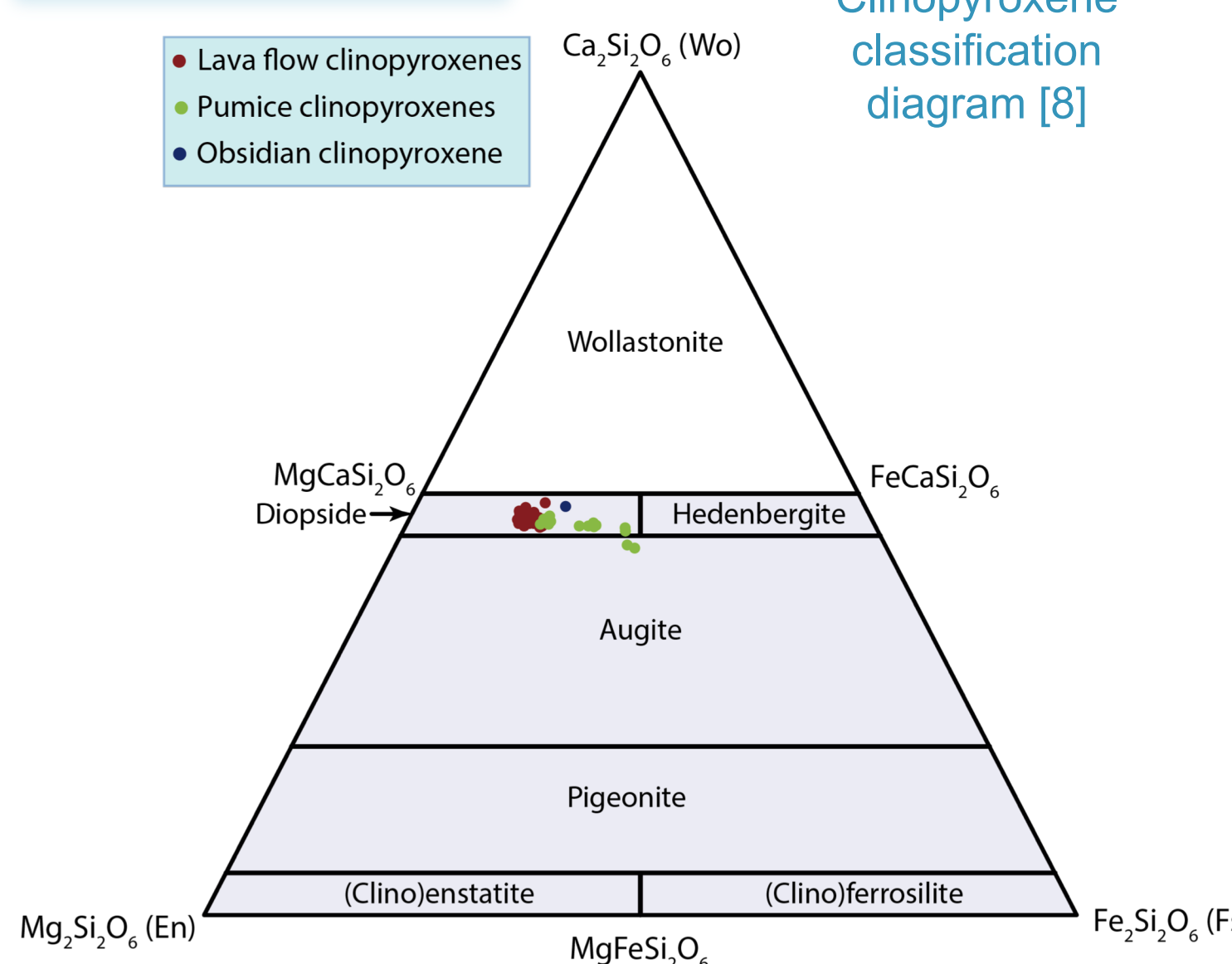
Feldspar zonations:

- Effusive phase** (lava flow): rims both enriched and depleted in anorthite.
- Explosive phase** (pumices): two poblations of feldspar, one equivalent to the lava's poblation and other more evolved.
- Small variations inside the crystals.

Representative feldspar phenocrysts zonations.

Clinopyroxenes

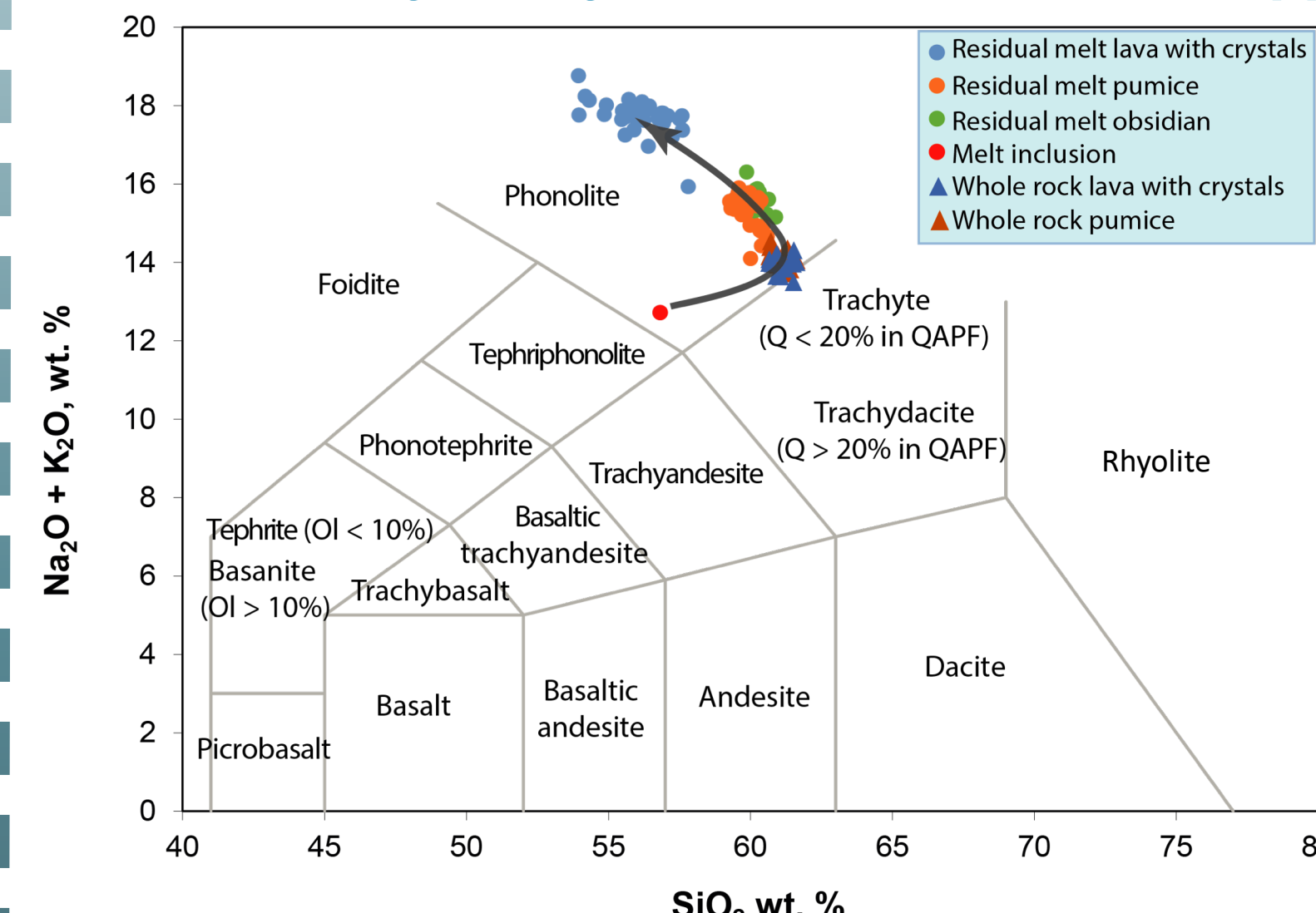
Clinopyroxene classification diagram [8]



- Ca-rich clinopyroxenes: **diopsides** and some augites.
- Zonations have only been found in the explosive phase, with cores enriched in Fe, na and Mn.
- Typically associated with **Fe-Ti oxides**: magnetite and ilmenite.

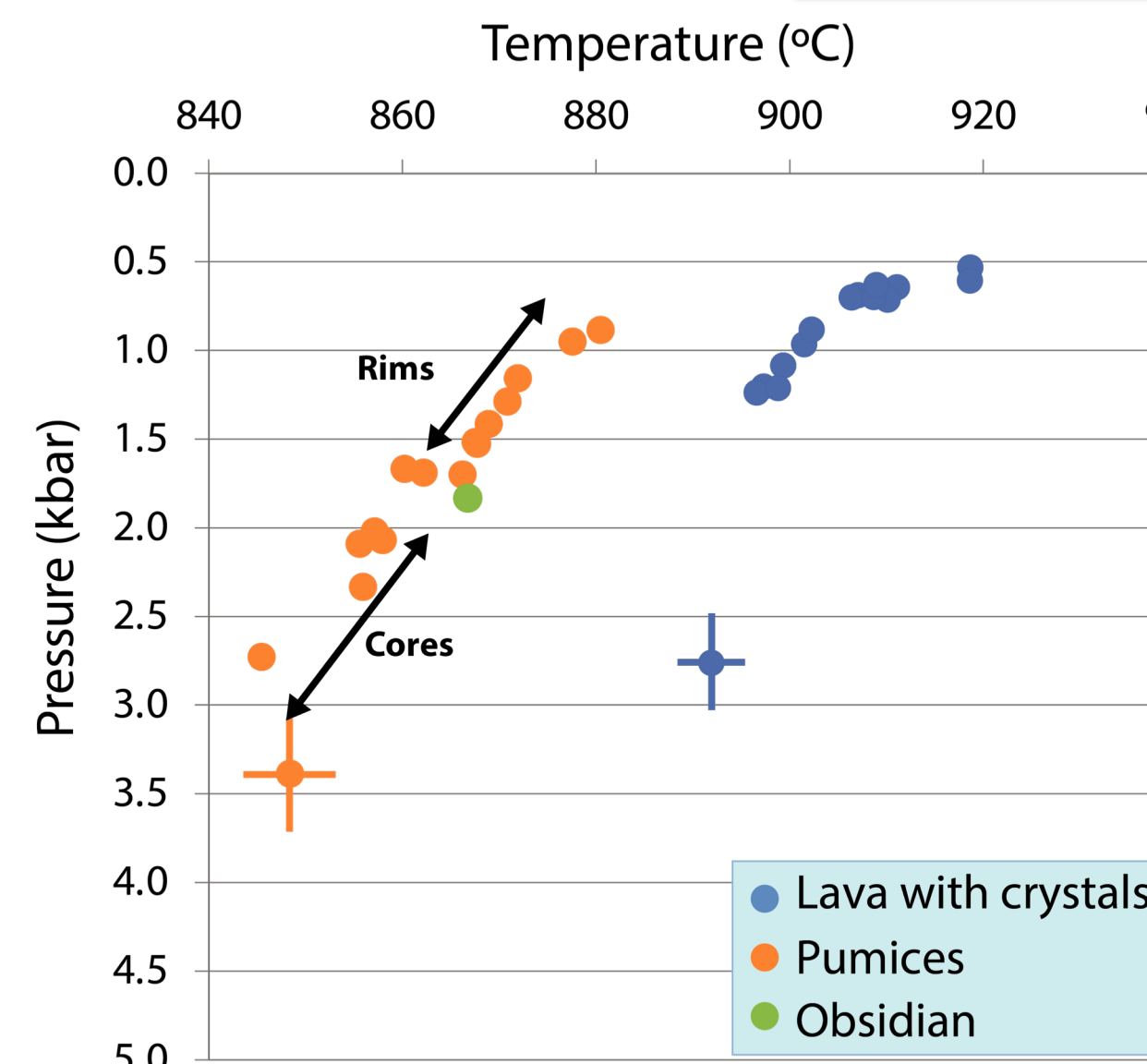
Whole rock, glass and volatiles

TAS diagram for glass and whole rock classification [9]



- Whole rock and glass: continuous evolution from glass inclusion to residual melt in lavas.
- Cl in melt from 0.2 to 0.6 wt% and Br from 10 to 15 ppm measured in the explosive phase.
- Sodalite**: indicator mineral of the presence of halogen gases in the fluid phase: **6.4-7.1 wt% Cl** and **130 ppm de Br**.

RESULTS: PRE-ERUPTIVE PARAMETERS (P, T H₂O)



- P-T: significant contrast in temperature results.
- H₂O: inverse relationship between dissolved water content and %An in feldspar. Some analysis do not pass the equilibrium test based in the K_D.
 - Effusive phase: average of 3.4 wt% H₂O.
 - Explosive phase: average of 5.4 wt% H₂O.

- High H₂O content calculations (>5.5 wt%) are **above water-saturation limit** in phonolitic magmas [10] → Is this geohygrometer poorly calibrated for phonolitic magmas?

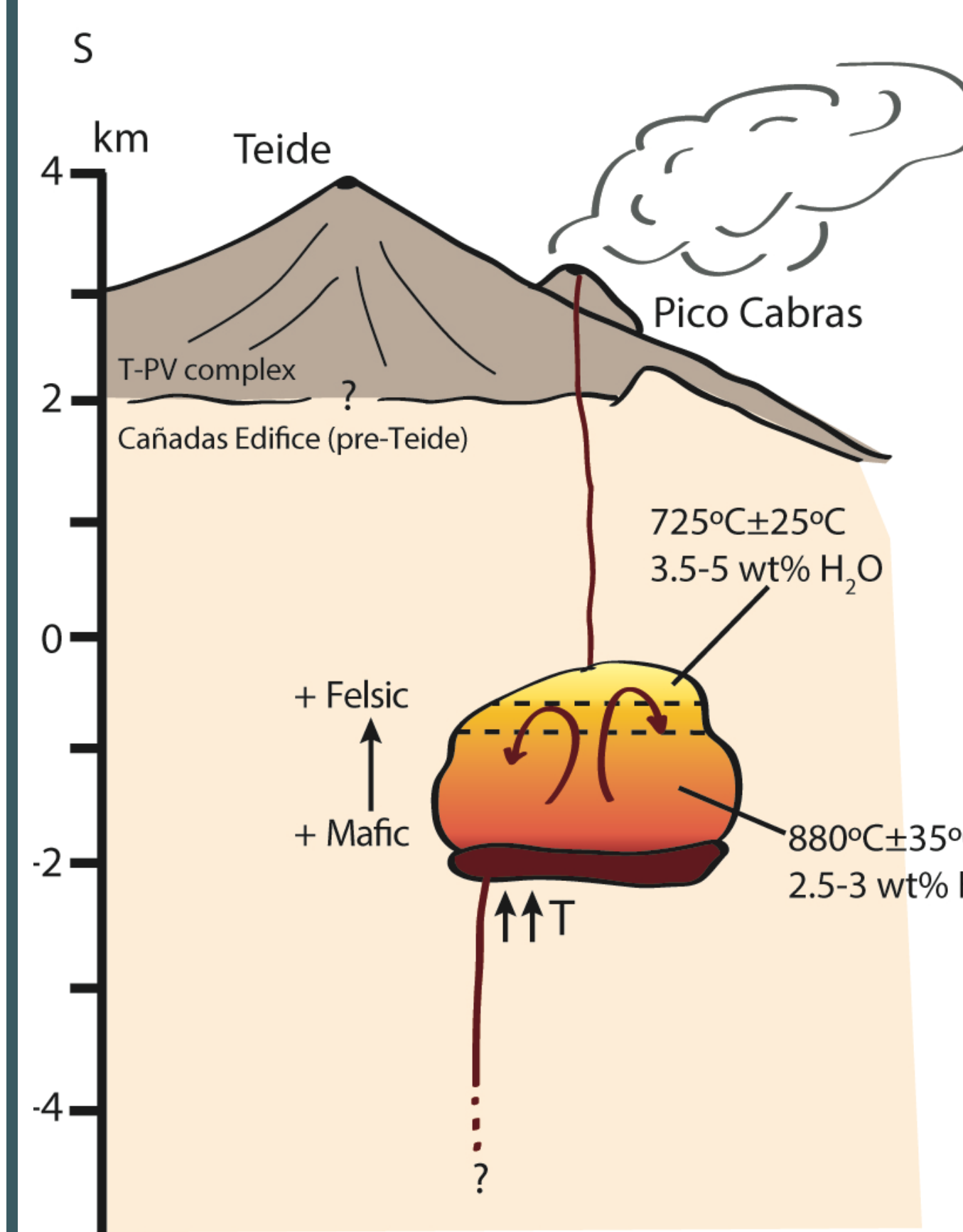
P-T diagram with data calculated using the geothermobarometer.

DISCUSSION AND CONCLUSIONS

P-T: **low accuracy** due to the difficulty obtaining the exact composition of the magma in equilibrium.

Comparison with the experimental mineral assemblage obtained by **experimental petrology**.

Model: magma chamber at 1kbar, chemical and thermally **zoned**. Zoning in minerals indicate **self-mixing** processes. Ca-rich rims in feldspars suggest **underplating** and **injection of a mafic magma** short time prior to eruption. This injection probably triggered the eruption.



Schematic model of Pico Cabras eruption's magma chamber. Pre-eruptive conditions within the magma chamber calculated in this work have been indicated. Scheme not to scale.

From Cl and Br measured in the explosive phase and the distribution coefficient between magma and fluid phase we estimate **244.6 Tm of Cl** and **9.9 Tm of Br** released to the **atmosphere** in this eruption.

CONCLUSIONS

- Pico Cabras eruption: magma chamber at 1 ± 0.5 kbar chemical and thermally zoned.
- The pre-eruptive parameters that controls the explosive-effusive transition are the temperature and the volatile content.
- The release of high amounts of Cl and especially, Br, may lead to a local destruction of the stratospheric ozone layer.
- Phonolitic dome eruptions in Tenerife should be taken into account for improving the hazard assessment of the island, with special focus on Icod valley.

BIBLIOGRAPHY

- Martí et al. (2011). *Journal of Volcanology and Geothermal Research*, 178(3), 529–542.
- Masotta et al. (2013). *Contributions to Mineralogy and Petrology*, 166(6), 1545–1561.
- Mollo et al. (2015). *Chemical Geology*, 392, 1–8.
- Andujar et al. (2008). *Chemical Geology*, 257(3–4), 173–191.
- Andujar et al. (2013). *Journal of Volcanology and Geothermal Research*, 260, 62–79.
- Andujar y Scaillet (2012). *Journal of Petrology*, 53(9), 1777–1806.
- Deer et al. (1972). *Journal of Geophysical Research: Atmospheres*, 104(D19), 23871–23880.
- Morimoto (1988). *Mineralogy and Petrology*, 39(1), 55–76.
- Le Bas et al. (1986). *Journal of Petrology*, 27(3), 745–750.
- Schmidt y Behrens (2008). *Chemical Geology*, 256(3–4), 259–268.

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